“Studies on Sustainable Crop Yeild Improvement Strategies in Turmeric Plantation in Nanded District”

A

Synopsis submitted to

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For faculty of science

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Introduction

Sustainable farming refers to agricultural systems and procedures that try to reduce the depletion of natural resources in the soil. Sustainable farming approaches strive to preserve more organic matter in the soil, reduce erosion and keep more carbon in the soil. These practices improve the resilience and long-term health of the soil, ultimately leading to higher yields. Sustainable agriculture development should achieve a balance between economic and environmental/social goals **Gutzler et al., (2015).** One of the most pressing concerns faced due to climate change, food insecurity and a dwindling agricultural resource base is how to build profitable farming systems that optimize the use of arable land and enhance farmer incomes. Agroforestry, which allows farmers to efficiency use their land resources at reduced environmental costs while producing a range of crops at different times, neatly solves these difficulties **Centre (2011).**

Agroforestry is a farming practice suitable for enhancing the ecosystem services produced by cropping systems. Among agroforestry systems, the alley-cropping system is characterized by the intercropping of crops and wide-row trees **Mosquera-Losada et al. (2011).** These systems offer a variety of products, including food, feed, fibres, fuel wood and timber, in addition to increasing the potential delivery of agro-ecosystem services **Rega et al., (2019).**

Turmeric (*Curcuma longa* L.) the ancient and sacred spice of India known as 'Indian saffron" is an important commercial spice crop grown in India. Turmeric is the dried rhizome of *Curcuma longa* L., an herbaceous perennial belonging to the family Zingiberaceae and a native of South Asia particularly India. The flowers are pale yellow and borne on dense spikes. The pseudo stems are shorter than leaves. The rhizomes are ready for harvesting in about 7 to 9 months after planting. It is used in diversified forms as a condiment, flavouring and colouring agent and as a principal ingredient in Indian culinary as curry powder. It has anti-cancer and anti-viral activities and hence finds use in the drug industry and cosmetics industry. 'Kumkum', popular with every house wife, is also a by-product of turmeric. It finds a place in offerings on religious and ceremonial occasions. A type of starch is also being extracts from a particular type of turmeric. The increasing demand for naturalproducts as food additives makes turmeric as ideal produce as a food colorants **(Khan et al., 2014**).

This commercial crop is grown for its tuberous rhizomes or underground stems used for imparting a palatable flavour and colour to food preparations after some special post-harvest/processing operations viz. clearing, curing, drying, polishing and powdering. India is the largest producer and exporter of turmeric in the world to various countries like USA, UK, Middle East, Japan, Singapore, Malaysia, South Africa, Australia and other countries, thus, India account for more than 50% of the world trade (**Chaudhary et al., 2006**; **APEDA, 2018**). Turmeric rhizomes after processing are used as condiments, a dye and as an aromatic stimulant in several medicines, preparations of curry powder, colouring matter in drugs, confectionary and food industries **(Khan et al., 2014).**

Turmeric has international importance also, India is the largest producer, consumer, and exporter of turmeric in the world. Other major producers are Thailand, other Southeast Asian countries, Central and Latin America and Taiwan. The global production of turmeric is around 11 lakh tonnes per annum. India dominates the world production scenario contributing 78% followed by China (8%), Myanmar (4%) and Nigeria and Bangla Desh together contributing to 6%of the global production.

India is the global leader in bare added products or turmeric and exports. Other major exporters are Thailand, other Southeast Asian countries, Central and Latin America and Taiwan. United Arab Emirates (UAE) is the major importer or turmeric from India accounting for 18% of the total exports followed by United States of America (USA) with 8%. The other leading importers are Bangladesh. Japan, SriLankan, United Kingdom, Malaysia, South Africa, Netherland and Saudi Arabia. All these countries together account for 75% of the world imports and Asian countries are the main suppliers to the entire worlds. The remaining 25% we net by Europe, North America and Central and Latin American countries. United States of America imports 97% of its turmeric requirement from India and the remaining portion from the Islands of the Pacific and Thailand. Out of the total global production UAE accounts for 18% of the imports, followed by USA (11%), Japan (9%), SriLanka, UK, Malaysia together accounting for 17%.

In India the turmeric is considered the best in the world market because of its high curcumin content. India exported 5150 tonnes of turmeric valued at Rs. 164.80 cores during 2006-07. From India’s total turmeric exports, 65% exported to UAE, USA, Japan, Srilanka, UK, and

Malaysia. The institutional sector in the west buys ground turmeric and oleoresins, while dry turmeric is preferred by the industrial sector.

Turmeric is available in two seasons in India i.e. February to May and August to October. The various varieties of turmeric that are traded in India are Allepey finger (Kerala), Erode turmeric (Tamil Nadu), Salem Turmeric (Tamil Nadu), Raja pore Turmeric (Maharashtra), Sangali Turmeric (Maharashtra), Nizamabad Bulb (Andhra Pradesh etc. The moor trading centers of turmeric are Nizamabad, Dugirala in Andhra Pradesh, sangali in Maharashtra and Salem, Erode Dharmapuri and Coimbatore in Tamil Nadu.

Turmeric rhizomes contain curcumin, a phenolic compound which is used in traditional medicines having properties of antibacterial, antifungal, antioxidant, ant parasitic and anti-inflammatory agent besides anticancer properties and induces apoptosis in a variety of cancer cells (Pisano, 2008). Recently, curcumin has been found to be ant depressive and hypolipidemic **(Bahl, 2014**).

Nanded is the District of Maharashtra State which is located in Marathwada Region. The climate in Nanded District is Subtropical and according to climate change the crop pattern of Nanded districts has been changed. Turmeric Production in Nanded District are more in Ardhapur taluka, Naygaon taluka, Mudkhed taluka etc. turmeric production in Nanded district is more last form 5 to 6 year we can say that after the Covid period.

Review of Literature

Kay et al., (2019) Studied about conventional agricultural practices, alley cropping is a more ecologically friendly strategy for land usage, biomass generation and sustainable food production. Alley cropping can deliver biomass resources in a sustainable manner and benefit the environment at the same time because it is a highly adaptable, low-input system.

Wolz et al., (2010) found that alley-cropping also serves as a potential adaptation strategy for reducing the consequences of climate change throughout its ecological advantages, such as buffers for weather extremes, reduced soil erosion, increased biodiversity and efficient nutrient and water utilization.

Fahrig et al., (2011) studied variety of crop plants, trees, ground-vegetation cover and plant canopy, alley-cropping can provide complex vegetation structural diversity compared to

monocultures, improving soil fertility (depending on the used species), water quality and carbon cycling.

Dharmraj et al., (2023) studied the primary component of turmeric is curcuma, which contains the three curcumins that give its varied physiological and therapeutic effects. The spice turmeric (curcuma longa), which has therapeutic characteristics, has been utilized extensively in South Asian traditional medical practices, particularly those in China and India. The current study reviews the research on curcumin's anti-inflammatory properties in the treatment of cancer. Studies have demonstrated that the highly pleiotropic substance curcumin interacts with a variety of molecular targets. A careful analysis of the literature review that curcumin, the main active component of turmeric, has a significant impact in the emergence of various malignancies. The majority of curcumin's anticancer potential comes from its ability to inhibit and/or a variety of intercellular transcription factors that regulate the production and growth of proteins are activated. An overview of the effects and mechanism of action is given in the current review.

Rahul Kumar et al., (2018) studied turmeric is an herbaceous evergreen plant in the Zingiberaceae (ginger) family. Turmeric (Curcuma longa) is extensively used as a spice, food preservative and colouring material in India, China and South East Asia. Turmeric powder is best known as one of the main ingredients used to make the curry spice; it also gives ballpark mustard its bright yellow colour. Apart from its culinary uses, turmeric has been used widely in the traditional medicine all over the world. Curcumin (diferuloylmethane), the main yellow bioactive component of turmeric has been shown to have a wide spectrum of biological actions. These include its anti-inflammatory, antioxidant, ant carcinogenic, ant mutagenic, anticoagulant, antifertility, antidiabetic, antibacterial, antifungal, antiprotozoal, and antiviral, ant fibrotic, ant venom, and antiulcer, hypotensive and hypercholesteraemic activities. For traditional Ayurveda's, turmeric plant was an excellent natural antiseptic, disinfectant, anti-inflammatory, and analgesic, while at the same time the plant has been often used to aid digestion, to improve intestinal flora, and to treat skin irritations.

Prasath et al., (2018) found that turmeric powder contains 2–8% curcumin, which is the main biologically active phytochemical compound. Moderate genetic variability exists in the crop, and cultivars vary in yield, cropping duration, and quality. Clonal selection has played a significant role in developing several high-yielding varieties. Turmeric is grown under both

rain-fed and irrigated conditions. It can also be grown as a component and intercrop with other crops. The crop is harvested seven to nine months after planting, depending on the cultivar, soil, and growing conditions. The scope of this review includes the taxonomy, morphology, cytology, genetic diversity, and improvement of turmeric. This review highlights research achievements of biotechnology and newfound knowledge in plant genomics, which will result in the development of promising cultivars. Horticultural aspects and postharvest processing of turmeric are also discussed.

Anil Choudhury and Shakuntala Rahi (2018) – Turmeric (*Curcuma longa* L.) is a major spice crop in India in general and north-western (NW) Himalayas in particular where it is grown mostly organic by default using biennial local strains having low productivity. This crop is becoming an alternate crop in monkey–menace areas in NW Himalayas transferring into gigantic fallow-lands otherwise. There is a dire need to boost turmeric productivity in the region by introducing high yielding turmeric cultivars (HYTCs). Thus, an extensive '*On–farm*' experimentation was done at 10 locations in 6 monkey–menace affected community-development-blocks (CBDs) (Sadar, Sunder agar, Dharampur, Gopalpur, Seraj and Gohar) of the randomly selected district–Mandi of the randomly selected Himalayan province–Himachal Pradesh as the study area. For this purpose, two newly released annually harvested HYTCs (*Palam Pitamber* and *Palam Lalima*) along with a widely grown local strain '*Suketi Haldi*' in NW Himalayas (as check), were planted along with organic manure *i.e.* FYM @ 20 t ha^{-1} on oven dry weight basis. Mean data of two years revealed that *Palam Pitamber* resulted in highest rhizome yield (32.94 t ha^{-1}) followed by *Palam Lalima* (32.35 t ha^{-1}) compared to biennially harvested '*Suketi Haldi*' (12.45 t ha^{-1}). Likewise, *Palam Pitamber* resulted in highest net returns and net B: C ratio (₹ 416,548 ha^{-1}; 5.38) followed by *Palam Lalima* and *Suketi Haldi*, respectively. The curcumin content was higher in '*Suketi Haldi*' (5.18%), but the curcumin yield was significantly higher in *Palam Pitamber* and *Palam Lalima*. The monetary-efficiency indices revealed that organic turmeric cultivation using HYTCs may fetch about 1243–1270 ₹ ha^{-1} day^{-1} to the Himalayan farmers. Overall, the turmeric rhizome yield was enhanced by about three–folds, profitability by 3–4 folds, resource-use efficiency (RUE) by 2–3 folds in terms of production– and monetary efficiency, water-use efficiency and partial factor productivity of applied nutrients (NPK) by the adoption of HYTCs coupled with FYM @ 20 t ha^{-1} over '*Suketi Haldi*'. Higher technology adoption rate (72–98%) and net income gains

(2.3–2.5 folds) in the study area advocated for employing '*Participatory-mode*' adaptive research methodologies following intensive technology transfer programme in remote hill agro-ecologies. In nutshell, the newly developed HYTCs exhibited great potential in boosting the turmeric productivity, profitability, curcumin yield and RUE vis-à-vis wider adaptability in monkey–menace areas toimprove rural livelihoods and make organic turmeric cultivation a promising agri–entrepreneurship in NW Himalayas.

Senthilkumar and Manivannan (2011) studied production and marketing of turmeric and chilli in Erode District. The main objective of the study is 1. To study the socio economic factors influencing production and marketing of turmeric and chilli 2.To study the ways and means to increase the productivity and effective marketing. They concluded that India's turmeric and chilli sector faces stiff challenges in increasing the efficiency in several of its sub-sectors: improving the technology in turmeric and chilli cultivation and processing, reforms in the marketing of turmeric and chilli and products domestically and internationally.

Moghe et al., (2012) in their study entitled "Design and Development of Turmeric Polishing Machine" examine the polishing machine for washing turmeric to remove unwanted impurities and scales of harvested turmeric. The paper presents the new design of turmeric polishing machine which is based on designed for manufacturing, assembly and maintenance. They concluded that the designed machine is very simple in operation, efficient in polishing of harvested turmeric at a good speed of production. This machine seems very simple at same time very efficient in polishing about 50 kg of harvested turmeric at a speed about of 75 rpm for about 20 min.

Tsvetkov et al., (2018) studied organic farming impacts the physical, chemical, and biological characteristics of soil, which in turn improves its fertility. It is considered an environmentally safe source, reduces pollution, is a renewable source for plant and soil nutrition and is less expensive compared to chemical fertilizers. Organic farming has increased tremendously in importance over the past 20 years, including in developing countries and the global market for organic products has grown

Objective of the Study

1. To assess the influence of biotic and abiotic factors on the growth and yields of turmeric plants
2. To determine the effective combination of microbial inoculants and organic Mannuring for Turmeric cultivation.
3. To evaluate improvement of soil quality and provide pure agriculture products.
4. To assess the cytotoxicity of turmeric products through Brine Shrimp lethality test.
5. To increase the quantity and quality of food by reducing the damage caused by living organisms
6. To provide alternative tools for crop improvement**.**

Methods and Materials

1. Preparation of Land
2. Planting
3. Seed Materials
4. Manuring and Fertilizer Application
5. Fertilizer Content
6. Mulching
7. Effects of Mulching on the yield of Turmeric
8. Sampling
9. Hypotropy
10. Quantitative Estimation Micro Organism
11. Soil Nutrient Analysis
12. Phytochemical Analysis
13. Statistical Analysis

Importance of Study/ Society Application

There are several importance of turmeric plant for a Human Society, Some are follows;

- In Ayurveda practices, turmeric is thought to have many medicinal properties including strengthening the overall energy of the body, relieving gas, dispelling worms, improving digestion, regulating menstruation, dissolving gallstones, and relieving arthritis.

- In Indian culture, the importance of turmeric goes far beyond medicine. The Hindu religion sees turmeric as auspicious and sacred. There is a wedding day tradition in which a string, dyed yellow with turmeric paste, is tied around the bride's neck by her groom.
- It is widely used in dye, drug and cosmetic industries. It is also used in pujas and religious ceremonies.
- The yield per acre of turmeric crop can vary from 18 to 24 quintals. Taking the average yield of 18 quintals, the total income generated from selling the turmeric crop would be Rs 1, 80,000-2, 00,000, assuming the price of turmeric is Rs 75 per kg.
- Turmeric boosts immunity, aids digestion, and helps prevent a range of monsoon-related illnesses, including respiratory infections and gastrointestinal disorders. Adding a pinch of turmeric to your daily cooking or drinking turmeric-infused milk can work wonders for your health.
- Several mechanisms by which turmeric may alleviate anosmia or agues induced by COVID-19 are plausible. Curcumin has been shown to bind and block the active site of Moro, the main protease utilized by COVID-19 to produce proteins required for viral replication from viral genomic RNA.

Proposed Work Plan

Total Three year proposed Work Plan for the topic:

First Year

First Six months

- Referencing
- Preperation of Land
- Mulching
- Mannuring and Fertilizer Application

Second year –

- Sampling
- Hypotropy Studies
- Quantitative Estimation of Micro Organism
- Soil Nutrient Analysis

Third Year –

- Phytochemical Analysis
- Statistical Analysis
- Compilation of data
- Thesis typing

Expected Outcome

- Influences of climatic factors occur during the mulching period.
- Turmeric plat morphological variation of mulch non mulch practiced rhizospheres soils
- In any climatic condition the plants will remain sustain.
- Improved quality of products of turmeric
- Effects of physical factors on microorganism they help in improving in growth of turmeric

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